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(FILE 'HOME' ENTERED AT 07:17:02 ON 08 JUL 2004)

FILE 'CA' ENTERED AT 07:17:13 ON 08 JUL 2004

L1 23877 S (PULSE# OR PULSING) (4A) (VOLATILE OR VAPOR? OR GAS? OR REACTION  
OR REACTANT OR REACTOR OR MICROREACTOR OR MINIREACTOR OR  
DEPOSITION OR DEPOSITING OR DEPOSIT)  
L2 61 S L1 AND (ATOMIC LAYER(1W)DEPOSIT? OR ALD OR ALCVD)  
L3 477531 S (PULSE# OR PULSING OR VOLATILE OR VAPOR? OR GAS? OR  
REACTANT) (6A) (DETECT? OR DETERMIN? OR ASSAY? OR ANALY? OR ASSESS?  
OR TEST? OR MEASUR? OR MONITOR? OR ESTIMAT? OR EVALUAT? OR EXAMIN?  
OR SENSE# OR SENSING OR PROBE# OR PROBING OR QUANTIF? OR  
QUANTITAT? OR CHECK?)  
L4 4636 S L1 AND L3  
L5 4772 S REACTANT(6A) (DETECT? OR DETERMIN? OR ASSAY? OR ANALY? OR ASSESS?  
OR TEST? OR MEASUR? OR MONITOR? OR ESTIMAT? OR EVALUAT? OR EXAMIN?  
OR SENSE# OR SENSING OR PROBE# OR PROBING OR QUANTIF? OR  
QUANTITAT? OR CHECK?)  
L6 61 S L1 AND L5  
L7 4575 S L4 NOT L6  
L8 4569 S L7 NOT L2  
L9 297 S L8 AND(CVD OR VAPOR DEPOSIT?)  
L10 2 S L9 AND(VALVE OR VALVING)  
L11 114 S L8 AND CONTROL? (4A) (PULSE# OR PULSING OR PULSESHAPE)  
L12 78 S L9 NOT(PULSE# OR PULSING OR PULSESHAPE) (3A) LASER  
L13 35 S L12 AND(HYBRID OR COMPUTER OR PULS? (1A) PLASMA)  
L14 268 S L2,L6,L10-11,L13  
L15 230 S (L14 NOT PY>2002)OR(L14 AND PATENT/DT AND PY<2004)  
L16 209 S L15 NOT(MINING OR POLAROG? OR PVC TUBE OR CLUSTER OR ELECTRODE  
REACTION OR BRANCH? OR MICEL?)  
L17 168 S L16 NOT(WELDING OR NUCLEAR REACTOR OR TUNNEL? OR LIQUID PHASE OR  
GAS DISCHARG? OR SPANISH OR FEMTOSE? OR FLUE)  
L18 150 S L17 NOT(FUSION REACTOR OR FUEL CELL OR WASTE? OR GAS LASER OR  
VORTEX OR CHEMILUM? OR SHOCK OR BOND CLEAVAGE)

=> d bib,ab 1-150 l18

L18 ANSWER 8 OF 150 CA COPYRIGHT 2004 ACS on STN  
AN 139:119310 CA  
TI Active **pulse** monitoring in a chemical **reactor**  
IN Bondestam, Niklas; Hendriks, Menso  
PA Finland  
SO U.S. Pat. Appl. Publ., 19 pp.  
PI US 2003143747 A1 20030731 US 2002-66169 20020130 <--  
PRAI US 2002-66169 A 20020130  
AB A method and app. for detg. changes in a supply system, designed to  
supply repeated **pulses** of a **vapor** phase **reactant** to a reaction chamber  
is disclosed. One embodiment involves providing the reactant source,  
and a gas conduit to connect the reactant source to the reaction  
chamber, a valve positioned in communication with the reactant source  
such that switching of the valve induces **vapor** phase **reactant** **pulses**

from the **reactant** source to the reaction chamber and a sensor positioned in communication with the reactant source and configured to provide a signal indicative of a characteristic parameter of the **reactant pulse** as a function of time. A curve is derived from the signal and the shape of the curve is monitored to det. changes in the curve shape over time during subsequent pulses. The method is suitable for monitoring vapor deposition processes such as in the manuf. of wafers.

L18 ANSWER 13 OF 150 CA COPYRIGHT 2004 ACS on STN

AN 138:258761 CA

TI **Atomic layer deposition** of metal or hard metal compound films controlled by a reduction pulse

IN Elers, Kai Erik; Li, Wei-Min

PA ASM America, Inc., USA; ASM Microchemistry Oy

SO PCT Int. Appl., 45 pp.

PI WO 2003025243 A2 20030327 WO 2002-US29032 20020910 <--

US 2003082296 A1 20030501 US 2002-242368 20020912 <--

PRAI US 2001-322385P P 20010914

AB Conformal metal or hard metal-compd. films are applied on substrates by cyclic **at.-layer deposition** process with alternating **pulses** of **reactants**. The chem.-vapor deposition cycle includes a metal halide reactant and a 2nd reactant with a species to be included in the film, and later a 3rd reactant capable of gettering residual halides from the monolayer deposit. The chem.-vapor deposition is suitable for growing the films of transition metal, nitride, carbide, and/or carbonitride, with the assocd. decrease in the amt. of corrosive chem. compd. (esp. H halides) during the deposition on metal or oxide substrates at nominally 225-400°. The getter compds. protect the substrate surfaces sensitive to H halides and NH4 halides (esp. Al, Cu, and/or SiO2) against corrosion. The process is suitable for nanolaminate structures incorporating metal films, esp. for elec.-circuit applications to form a diffusion barrier <20 nm thick. The complex film applied by cyclic deposition is optionally W carbonitride applied using controlled cyclic flow of WF6, NH3, and triethylboron.

L18 ANSWER 15 OF 150 CA COPYRIGHT 2004 ACS on STN

AN 138:115335 CA

TI Apparatus and method for growth of a thin film

IN Raaijmakers, Ivo

PA ASM America, Inc., USA

SO U.S., 12 pp.

PI US 6511539 B1 20030128 US 1999-392371 19990908 <--

PRAI US 1999-392371 A 19990908

AB Described is an improved app. and method for substrate layer deposition in which substrate layers are grown by carrier **gas** delivery of sequential **pulses** of **reactants** to the substrate surface. At least one of the reactants comprises excited species, e.g., radicals. In a specific embodiment, the app. of this invention provides sequential repeated **pulses** of **reactants** in a flow of carrier gas for reaction at a substrate surface. The **reactant pulses** are delivered with sufficient

intervening delay times to minimize undesirable **reaction** between **reactants** in adjacent **pulses** in the **gas** phase or undesired uncontrolled reactions on the substrate surface.

L18 ANSWER 22 OF 150 CA COPYRIGHT 2004 ACS on STN

AN 136:410047 CA

TI Plasma enhanced **pulsed** layer **deposition**

IN Nguyen, Tue

PA Simplus Systems Corporation, USA

SO PCT Int. Appl., 36 pp.

PI WO 2002043114 A2 20020530 WO 2001-US43573 20011121 <--

US 6689220 B1 20040210 US 2000-721162 20001122

PRAI US 2000-721162 A 20001122

AB A process system and a deposition method for depositing a highly controlled layered film on a workpiece is disclosed. The basis component of the present invention app. is a pulsing plasma source capable of either exciting or not-exciting a first precursor. The pulsing plasma source includes an energy source to generate a plasma, and a plasma adjusting system to cause the plasma to either excite or not-excite a precursor. The precursor could flow continuously (an aspect totally new to **ALD**), or intermittently (or pulsing, std. **ALD** operation process). The present invention further provides a method to deposit highly controlled layered film on a workpiece. The method comprises the steps of pulsing the plasma to excite/not-excite the precursors and the ambient to deposit and modify the depositing layers. This procedure then can be repeated alternately until the film reaches a desired thickness.

L18 ANSWER 30 OF 150 CA COPYRIGHT 2004 ACS on STN

AN 136:46011 CA

TI Thin film forming method for a semiconductor device

IN Koh, Won Yong; Lee, Chun Soo

PA Genitech Inc., S. Korea

SO PCT Int. Appl., 40 pp.

PI WO 2001099166 A1 20011227 WO 2001-KR974 20010608 <--

PRAI KR 2000-31367 A 20000608

AB A method for forming thin films of a semiconductor device is provided. The thin film formation method presented here is based upon a time-divisional process gas supply in a CVD method where the process gases are supplied and purged sequentially, and addnl. plasma is generated in synchronization with the cycle of **pulsing reactant gases**. A method of forming thin films that possess a property of gradient compn. profile is also presented.

L18 ANSWER 33 OF 150 CA COPYRIGHT 2004 ACS on STN

AN 136:13048 CA

TI Trimethylaluminum as a reducing agent in the **atomic layer deposition** of Ti(Al)N thin films

AU Juppo, Marika; Alen, Petra; Ritala, Mikko; Leskela, Markku

CS The Laboratory of Inorganic Chemistry Department of Chemistry, University of Helsinki, Helsinki, FIN-00014, Finland

SO Chemical Vapor Deposition (2001), 7(5), 211-217  
AB Ti(Al)N thin films were deposited by **at. layer deposition (ALD)** from Ti tetrachloride, NH<sub>3</sub>, and trimethyl-Al. The most important role of trimethylaluminum was to act as an extra reducing agent to lower the required deposition temp. The films were deposited using four different schemes, where the pulsing order and **pulse** time of the **reactants**, and the deposition temp., were varied. The film properties were analyzed by energy dispersive x-ray spectroscopy (EDX), time-of-flight elastic recoil detection anal. (TOF-ERDA), XRD, and resistivity measurements. Addnl., the diffusion barrier properties of selected 10 nm thick films were studied. Both C and Al were incorporated into the Ti(Al)N films. Despite that, at deposition temps. of 400° and lower, Ti(Al)N films exhibited better characteristics than TiN films deposited from Ti tetrachloride and NH<sub>3</sub>.

L18 ANSWER 36 OF 150 CA COPYRIGHT 2004 ACS on STN

AN 135:281076 CA

TI Coherent Raman spectroscopic monitoring of pulsed radio frequency PECVD of silicon nitride thin films

AU Phillips, B. J.; Steidley, S. D.; Lau, L. D.; Rodriguez, R. G.

CS Department of Chemistry, Idaho State University, Pocatello, ID, 83209, USA

SO Applied Spectroscopy (2001), 55(7), 946-951

AB During **pulsed** plasma enhanced chem. **vapor deposition**, (PECVD), of silicon nitride thin films, depletion of silane **reactant** was **measured** by coherent anti-Stokes Raman scattering, (CARS), spectroscopy as a function of radio frequency pulse width, peak power, and delay time after the rf pulse. The results were correlated with "goodness of deposition parameters" including film thickness, deposition rate, and N-H and Si-H film content. The pulse width and peak power affected the plasma similarly, as silane depletion, film thickness, and rate of film growth all increased with both pulse width and peak power for a 10 Hz repetition rate. The CARS measured silane depletion also increased proportionally with pulse width for short rf pulses but not for long ones. Although the film properties changed with both power and pulse width, there were differences in the effects. A decreasing SiH/NH ratio resulted from increasing peak power, but increases in pulse width lead to an increasing ratio in some cases. The delay studies showed the CARS-measured silane depletion was higher 2 ms after the rf pulse had ended than 0.5 ms within the pulse. This result was accounted for by the flow rate, shower head design, and placement of the focus of the laser beams. Based on the results of the CARS-measured silane depletion as a function of pulse width and delay time, it is evident that the reactants move in a segregated-flow with a significant proportion of the velocity component directed toward the lower electrode, at least for the conditions of this expt. Thus differences noted between pulsed and continuous PECVD processing likely depend largely on the transit time of the mols. in the plasma region.

L18 ANSWER 38 OF 150 CA COPYRIGHT 2004 ACS on STN

AN 135:219702 CA



TI Method of forming metal layer using **atomic layer deposition** and semiconductor device having the metal layer as barrier metal layer or upper or lower electrode of capacitor  
 IN Kang, Sang-bom; Lim, Hyun-seok; Chae, Yung-sook; Jeon, In-sang; Choi, Gil-heyun  
 PA Samsung Electronics Co, Ltd., S. Korea  
 SO U.S., 24 pp.  
 PI US 6287965 B1 20010911 US 2000-511598 20000223 <--  
 PRAI KR 1997-35587 A 19970728  
 AB A method of forming a metal layer having excellent thermal and oxidn. resistant characteristics using **at. layer deposition** is provided. The metal layer includes a reactive metal (A), an element (B) for the amorphous combination between the reactive metal (A) and nitrogen. The reactive metal (A) may be Ti, Ta, W, Zr, Hf, Mo, or Nb. The amorphous combination element (B) may be Al, Si, or B. The metal layer is formed by alternately injecting **pulsed** source **gases** for the elements (A, B and N) into a chamber according to **at. layer deposition** to thereby alternately stack at. layers. Accordingly, the compn. ratio of a N compd. (A-B-N) of the metal layer can be desirably adjusted just by appropriately detg. the no. of injection **pulses** of each source **gas**. According to the compn. ratio, a desirable elec. cond. and resistance of the metal layer can be accurately obtained. The at. layers are individually deposited, thereby realizing excellent step coverage even in a complex and compact region. A metal layer formed by **at. layer deposition** can be employed as a barrier metal layer, a lower electrode or an upper electrode in a semiconductor device.

L18 ANSWER 47 OF 150 CA COPYRIGHT 2004 ACS on STN  
 AN 134:200877 CA  
 TI DLC films formed by **hybrid pulse plasma** coating (HPPC) system  
 AU Awazu, K.; Sakudo, N.; Yasui, H.; Saji, E.; Okazaki, K.; Hasegawa, Y.; Ikenaga, N.; Kanda, K.; Nambo, Y.; Saitoh, K.  
 CS The Hokuriku Industrial Advancement Center, Ishikawa, Kanazawa, 920-0918, Japan  
 SO Surface and Coatings Technology (2001), 136(1-3), 172-175  
 AB A new coating system was developed which consists fundamentally of plasma **CVD** (chem. **vapor deposition**) and ion-mixing. The system employs **pulsed-gas** introduction, **pulsed-plasma** generation and plasma base ion implantation (PBII). In this paper the formation of DLC films by the HPPC system is reported. The plasma densities were measured using a Langmuir probe and a 10-GHz microwave interferometer. DLC films were formed on the surface of work-pieces using hydrocarbon **gases** by the HPPC system, with **monitoring** plasma d. during the coating process. Raman spectra of DLC films by the HPPC system are similar in shape to those by ion-plating, and the fractions of amorphous and graphite components in Raman spectrum gained by segregated four peaks decreased with the decrease of CH<sub>4</sub>/C<sub>7</sub>H<sub>8</sub> partial pressure ratios. The reason is considered that the larger the deposition rates of films become, the smaller the ion-mixing effects are. Furthermore, as the CH<sub>4</sub>/C<sub>7</sub>H<sub>8</sub> ratio becomes as low as 1, this phenomenon becomes more apparent. For the further study, the plasma d. as well as the change in **gas** pressure in

the chamber must be **monitored** for the formation of uniform DLC films.

L18 ANSWER 52 OF 150 CA COPYRIGHT 2004 ACS on STN

AN 133:365108 CA

TI The mechanism of Si incorporation and the digital control of Si content during the metallorganic **atomic layer deposition** of Ti-Si-N thin films

AU Min, Jae-Sik; Park, Jin-Seong; Park, Hyung-Sang; Kang, Sang-Won

CS Department of Materials Science and Engineering, Korea Advanced Institute of Science and Technology, Taejon, 305-701, S. Korea

SO Journal of the Electrochemical Society (2000), 147(10), 3868-3872

AB Ti-Si-nitride thin films were grown by metalorg. **at. layer deposition** (MOALD) using tetrakis(dimethylamido)titanium (TDMAT), NH<sub>3</sub>, and silane at 180°. When the reactants are injected into the reactor in the sequence of TDMAT pulse, SiH<sub>4</sub> pulse, and NH<sub>3</sub> pulse, the Si content in the Ti-Si-N films is satd. at 18 atom %. By changing the supplying sequence in the order of TDMAT, NH<sub>3</sub>, and SiH<sub>4</sub>, the Si content is increased to 21 atom %. The Si content in the films is almost insensitive to the SiH<sub>4</sub> partial pressure over a wide range of 0.27 and 13.3 Pa, because it is self-limited by the quantity of SiH<sub>4</sub> mols. absorbed on the film surface. By using these inherent characteristics of MOALD, digital control of Si content in Ti-Si-N thin film is possible by controlling the no. of SiH<sub>4</sub> **pulses** during film **deposition**. The MOALD Ti-Si-N films have almost 100% step coverage on a 0.3 µm diam. hole with an aspect ratio of 10:1. MOALD is considered to be a promising deposition method for <10 nm thick Ti-Si-N films as a Cu diffusion barrier film.

L18 ANSWER 54 OF 150 CA COPYRIGHT 2004 ACS on STN

AN 133:274763 CA

TI **Computer controlled pulsed PECVD reactor** for laboratory scale deposition of plasma polymerized thin films

AU Pedrow, P. D.; Shepsis, L. V.; Mahalingam, R.; Osman, M. A.

CS EECS Department, Washington State University, Pullman, WA, 99164, USA

SO Materials Research Society Symposium Proceedings (2000), 600(Electroactive Polymers (EAP)), 325-331

AB A **pulsed PECVD reactor** has been successfully constructed for lab. scale studies of plasma polyimd. thin films. A **computer** control system based on National Instrument's LABVIEW software controls power supply sequence, feed injection, and introduction of RF energy. An optical fiber and a photo diode allow the user to **monitor** the emitted light for each **pulse**. A fast ionization gauge is used to characterize the pressure evolution over time, subsequent to acetylene gas injection. Substrates with diam. as large as 10 cm can be accommodated within the reactor. Both aniline liq. and acetylene gas have been used as reactor feed. The deposited plasma-polyimd. films were characterized using AFM and SEM. Elec. cond. of plasma polyimd. acetylene film was also measured.

L18 ANSWER 56 OF 150 CA COPYRIGHT 2004 ACS on STN

AN 133:142712 CA

TI **Atomic Layer Deposition** and Chemical Vapor Deposition of Tantalum Oxide

by Successive and Simultaneous Pulsing of Tantalum Ethoxide and Tantalum Chloride

AU Kukli, Kaupo; Ritala, Mikko; Leskelae, Markku  
CS Department of Chemistry, University of Helsinki, FIN-00014, Finland  
SO Chemistry of Materials (2000), 12(7), 1914-1920  
AB Amorphous Ta<sub>2</sub>O<sub>5</sub> films were grown by **at. layer deposition (ALD)** or **pulsed** CVD processes as a result of reactions between Ta(OEt)<sub>5</sub> and TaCl<sub>5</sub>. **Pulses** of **vaporized** Ta precursors were led into the reactor successively or simultaneously. H<sub>2</sub>O could be applied as a supplementary oxygen source, but the films could be grown also in a water-free process. Films were grown at 275-450°. The growth rate of the films obtained by CVD using simultaneous pulsing of precursors exceeded 2.5 times that of the films obtained in the **ALD** process, where only one metal precursor was applied at a time. The refractive index and permittivity of the films increased with the growth temp. and frequency of Ta precursor pulses, approaching the values characteristic of the films obtained in the conventional **ALD** or CVD processes.

L18 ANSWER 57 OF 150 CA COPYRIGHT 2004 ACS on STN

AN 133:10360 CA

TI Real-time optical characterization and control of heteroepitaxial GaIn<sub>1-x</sub>P growth by p-polarized reflectance.

AU Dietz, N.; Ito, K.; Lauko, I.; Woods, V.

CS Departments of Physics and Materials Science & Engineering, North Carolina State University, Raleigh, NC, 27696-7919, USA

SO Materials Research Society Symposium Proceedings (2000), 591(Nondestructive Methods for Materials Characterization), 307-312

AB The characterization and control of thin film growth processes requires improved methods of characterization and understanding of decompn. pathways and surface reaction kinetics under steady-state epitaxial growth involving organometallic precursors. In this contribution the authors present the application of p-polarized reflectance spectroscopy (PRS) for real-time **monitoring** and **control** of **pulsed** chem. beam epitaxy (PCBE) during low temp. growth of epitaxial Ga<sub>1-x</sub>In<sub>x</sub>P heterostructures on Si(001) substrates by PCBE, where the growth surface is sequentially exposed to organometallic precursors. During the **pulsed** precursor supply the surface **reaction** kinetics can be followed by analyzing a periodically in compn. and thickness modulated surface reaction layer (SRL), which is captured in the PR-signals as a fine structure that is superimposed to the interference fringes caused due to the underlying growing film. The optical response is linked to the growth process via a reduced order surface kinetics (ROSK) model and integrated as a control signal in the implementation of filter and control algorithms for closed-loop controlled growth of epitaxial Ga<sub>1-x</sub>In<sub>x</sub>P heterostructures on Si(001) substrates. The control concept was applied for thickness and compositional graded multi-heterostructure GaIn<sub>1-x</sub>P epilayers and validated by ex-situ post-growth anal., showing superior tracking of compn. and thickness targets under closed loop controlled conditions compared to films grown using pre-designed source injection profiles (open-loop conditions).

L18 ANSWER 67 OF 150 CA COPYRIGHT 2004 ACS on STN  
AN 132:28781 CA  
TI CFD simulation of **pulsed** MOCVD to reduce **gas**-phase parasitic reaction  
AU Zhou, Ning; Lowry, Samuel A.; Krishnan, Anantha  
CS CFD Research Corp., Huntsville, AL, USA  
SO Proceedings of SPIE-The International Society for Optical Engineering  
(1999), 3792 (Materials Research in Low Gravity II), 58-72  
AB A computational fluid dynamics (CFD) code is used to **det.** the potential  
benefit of **pulsed** metalorg CVD. When AlN is grown using MOCVD over a  
range of pressures and substrate temps., gas-phase mixing of the  
precursor and ammonia hydride leads to adduct formation. This adduct  
formation may produce some undesired particulate byproducts and deplete  
the precursors at elevated pressure and temp. To reduce this **gas**-phase  
parasitic **reaction**, the **pulsed** inlet condition as proposed by Bachmann  
et al. Is used to effectively sep. the precursor from ammonia in gas-  
phase. It is predicted that for high reactor pressure, the growth  
efficiency of AlN can be enhanced by a factor of 3 through the pulsed  
MOCVD technique while simultaneously reducing the particle formation.  
The improvement by pulsed MOCVD is also demonstrated for a proposed 3-  
dimensional research reactor.

L18 ANSWER 68 OF 150 CA COPYRIGHT 2004 ACS on STN  
AN 131:340517 CA  
TI **Pulsed** and continuous wave plasma **deposition** of amorphous, hydrogenated  
silicon carbide from SiH<sub>4</sub>/CH<sub>4</sub> plasmas  
AU McCurdy, Patrick R.; Truitt, Jason M.; Fisher, Ellen R.  
CS Department of Chemistry, Colorado State University, Fort Collins, CO,  
80523-1872, USA  
SO Journal of Vacuum Science & Technology, A: Vacuum, Surfaces, and Films  
(1999), 17(5), 2475-2484  
AB Continuous wave (cw) and equivalently powered, pulsed radio frequency  
plasmas are used to deposit amorphous, hydrogenated silicon carbide (a-  
Si<sub>1-x</sub>C<sub>x</sub>:H) films. Films produced from SiH<sub>4</sub>/CH<sub>4</sub> and SiH<sub>4</sub>/CH<sub>4</sub>/H<sub>2</sub> **gas**  
mixts. were **analyzed** with Fourier-transform IR, XPS, SEM, and  
profilometry. Gas-phase plasma species were identified using optical  
emission spectroscopy. The effects of biasing ( $\pm 1000$  V) and grounding  
the substrates, pulse peak power, pulse on time and off time, and duty  
cycle on film compn. were examd. Films deposited with cw plasmas show  
an increase in hydrogen incorporation compared to films deposited in  
the pulsed systems. In the **pulsed plasmas**, **deposition** rates depend on  
both the on time and off time of the **plasma pulse** cycle, while  
grounding the substrate causes a significant redn. in oxidn. rates for  
films deposited under all conditions.

L18 ANSWER 81 OF 150 CA COPYRIGHT 2004 ACS on STN  
AN 129:296319 CA  
TI **Atomic layer deposition** of TiN films by alternate supply of  
tetrakis(ethylmethlamino)titanium and ammonia  
AU Min, Jae-Sik; Son, Young-Woong; Kang, Won-Gu; Chun, Soung-Soon; Kang,  
Sang-Won  
CS Dep. Materials Sci. Eng., Korea Advanced Inst. Sci. Technol., Taejon,



S. Korea

SO Japanese Journal of Applied Physics, Part 1: Regular Papers, Short  
Notes & Review Papers (1998), 37(9A), 4999-5004

AB **At. layer deposition (ALD)** of amorphous TiN films on SiO<sub>2</sub> between 170° and 210° was studied by alternate supply of reactant sources, Ti[N(C<sub>2</sub>H<sub>5</sub>CH<sub>3</sub>)<sub>2</sub>]<sub>4</sub> [tetrakis(ethylmethlamino)titanium:TEMAT] and NH<sub>3</sub>. Reactant sources were injected into the reactor in the following order: **TEMAT vapor pulse**, **Ar gas pulse**, **NH<sub>3</sub> gas pulse** and **Ar gas pulse**. Film thickness per cycle was satd. at ~1.6 monolayers (ML) per cycle with sufficient **pulse** times of **reactant** sources at 200°. Probably film thickness per cycle could exceed 1 ML/cycle in **ALD**, and are explained by chemisorption mechanism of the reactant sources. An ideal linear relation between no. of cycles and film thickness is confirmed. As a result of surface limited reactions of **ALD**, step coverage was excellent. Particles caused by the gas phase reactions between TEMAT and NH<sub>3</sub> were almost absent because TEMAT was segregated from NH<sub>3</sub> by the Ar pulse. In spite of relatively low substrate temp., C impurity was incorporated <4 at.%.

L18 ANSWER 86 OF 150 CA COPYRIGHT 2004 ACS on STN

AN 128:272261 CA

TI Fused Chemical Reactions: The Use of Dispersion To Delay Reaction Time in Tubular Reactors

AU Singh, Probjot; Fogler, H. Scott

CS Department of Chemical Engineering, University of Michigan, Ann Arbor, MI, 48109, USA

SO Industrial & Engineering Chemistry Research (1998), 37(6), 2203-2207

AB Fused chem. reactions are delayed exothermic reactions. An axial dispersion model is used to simulate the flow of alternately injected **pulses of reactants** sepd. by an inert. There is a delay in reaction and heat release because the reactants have to disperse through the inert spacer to react. The feasibility of this technique is described for the reaction between ammonium chloride and sodium nitrite catalyzed by acetic acid. This technique can be successfully applied to the effective dissoln. of wax deposited in subsea pipelines. The delay in the reaction is required to supply heat to regions further down the pipeline that are more susceptible to wax deposition. Simulation results show that the delay in the heat release depends on the width of the inert spacer as well as the catalyst concn. However, the amt. of heat released depends on the inlet concns. of the reactants. Simulations can successfully **det.** the inlet concns. of the **reactants** and catalyst as well as the inert spacer width for a desired temp. profile inside the pipeline.

L18 ANSWER 94 OF 150 CA COPYRIGHT 2004 ACS on STN

AN 126:219339 CA

TI Real-time process sensing and metrology in amorphous and selective area silicon plasma enhanced chemical vapor deposition using in-situ mass spectrometry

AU Chowdhury, Ashfaqul I.; Read, Walter W.; Rubloff, Gary W.; Tedder, Laura L.; Parsons, Gergory N.

- CS Eng. Res. Center ADvanced Electronic Materials Processing, North Carolina State Univ., Raleigh, NC, 27695, USA
- SO Journal of Vacuum Science & Technology, B: Microelectronics and Nanometer Structures (1997), 15(1), 127-132
- AB The authors have used mass spectroscopy to observe and **analyze**, in real-time, gas phase **reactants** and product species in plasma-enhanced CVD deposition (PECVD) of silicon. They describe a doubly differentially pumped mass spectrometry system to sample the exhaust stream of a large-area plasma CVD reactor operating at 0.4-1.5 torr. They show real-time quant. anal. of silane consumption and hydrogen prodn. for deposition of hydrogenated amorphous silicon and for **pulsed-gas** selective area silicon **deposition**. The ability of mass spectrometry to observe process faults in real time is also demonstrated. Mass spectroscopy is a useful nonintrusive process-state sensor for real-time metrol. of plasma deposition, for example, to quantify gas phase species, and to characterize reactions occurring on the substrate surface. Based on their results, the authors discuss potential advanced manufg. applications of real-time mass spectrometry in amorphous silicon and selective area silicon plasma deposition, including indirect wafer-state sensing, fault anal. and classification, and run-to-run and real-time process control.
- L18 ANSWER 95 OF 150 CA COPYRIGHT 2004 ACS on STN
- AN 126:67737 CA
- TI Control of thin film structure by reactant pressure in **atomic layer deposition** of TiO<sub>2</sub>
- AU Aarik, Jaan; Aidla, Aleks; Sammelselg, Vaeino; Siimon, Hele; Uustare, Teet
- CS Institute of Experimental Physics and Technology, University of Tartu, Tartu, EE-2400, Estonia
- SO Journal of Crystal Growth (1996), 169(3), 496-502
- AB At. layer growth of TiO<sub>2</sub> films from TiCl<sub>4</sub> and H<sub>2</sub>O was examd. Polycryst. films of pure rutile, pure TiO<sub>2</sub>-II, or a mixt. of them could be obtained at the same growth temp. (400°) and at the same TiCl<sub>4</sub> vapor pressure (0.34 Pa) applying different H<sub>2</sub>O **vapor** pressures during the H<sub>2</sub>O **pulse**. Possible growth mechanisms giving different structures are discussed.
- L18 ANSWER 99 OF 150 CA COPYRIGHT 2004 ACS on STN
- AN 125:100567 CA
- TI Fabrication of diamond films at low temperature by pulse-modulated magneto-active microwave plasma **CVD**
- AU Hatta, A.; Suzuki, H.; Kadota, K.; Makita, H.; Ito, T.; Hiraki, A.
- CS Department Electrical Engineering, Osaka University, Suita, 565, Japan
- SO Plasma Sources Science & Technology (1996), 5(2), 235-240
- AB A magneto-active microwave plasma **CVD** technique was developed by pulse modulation of the discharge to reduce the time-averaged microwave power for diamond film synthesis at low temp. Due to a threshold power being required to start growth, the practical growth rate obtained by using the **pulse-modulated plasma** became three times larger than that obtained by using a continuous plasma of time-averaged power near the threshold.

The Me radical d. was **measured** in continuous or **pulse**-modulated plasma by IR laser absorption spectroscopy and compared to the growth rate. The time-averaged Me radical d. was also enhanced by pulse modulation; it was up to 1.3 times larger than that in the continuous plasma. Though the correlation between Me d. and diamond growth rate was not clear, the no. of C atoms supplied as Me radicals was larger than the actual growth rate by almost two orders of magnitude.

L18 ANSWER 101 OF 150 CA COPYRIGHT 2004 ACS on STN  
AN 125:14588 CA  
TI Single pellet reactor for the dynamic analysis of gas-solid reactions  
"reaction of SO<sub>2</sub> with activated soda"  
AU Kopac, Turkan; Dogu, Gulsen; Dogu, Timur  
CS Dep. of Chemical Engineering, Gazi Univ., Ankara, Turk.  
SO Chemical Engineering Science (1996), 51(10), 2201-2209  
AB Single-pellet moment technique which was initially proposed for the measurement of effective diffusivities in porous catalysts and adsorption rate and equil. consts. was modified for the anal. of gas-solid reaction. In this technique dynamic version of the Wicke-Kallenbach single-pellet cell was used. A **pulse** of a tracer **gas** was introduced into stream flowing over one end face of the pellet. In the modified pulse-double response procedure, exptl. moments of the response peaks of both **reactant** and product gases **measured** in both top and bottom outlet streams of the single-pellet reactor were used for the evaluation of intra-pellet rate and equil. parameters. Application of the technique to the reaction of SO<sub>2</sub> with activated soda indicated that the value of Thiele modulus decreased from 6.74 to 0.33 by increasing the fractional conversion of Na<sub>2</sub>CO<sub>3</sub> to Na<sub>2</sub>SO<sub>3</sub> from 0 to 0.63. In this range of conversion values a significant variation in pore structure and also a decrease of effective diffusivity of SO<sub>2</sub> from 0.045 to 0.025 cm<sup>2</sup>/s was obsd. A cell model which considered the changes in pore length and radius with reaction extent and variations in product layer diffusion resistance was shown to be successfully used in the anal. of exptl. observations. A summary of single-pellet dynamic reactor studies for catalytic and noncatalytic gas-solid reactions is also given.

L18 ANSWER 115 OF 150 CA COPYRIGHT 2004 ACS on STN  
AN 119:197367 CA  
TI Design and calibration of **pulsed vapor** generators for 2,4,6-trinitrotoluene, cyclo-1,3,5-trimethylene-2,4,6-trinitramine, and pentaerythritol tetranitrate  
AU Davies, John P.; Blackwood, Larry G.; Davis, Sean G.; Goodrich, Lorenzo D.; Larson, Ronald A.  
CS Idaho Natl. Eng. Lab., EG and G Idaho Inc., Idaho Falls, ID, 83415, USA  
SO Analytical Chemistry (1993), 65(21), 3004-9  
AB Computer-**controlled pulsed** explosive **vapor** generators for 2,4,6-trinitrotoluene (TNT), cyclo-1,3,5-trimethylene-2,4,6-trinitramine (RDX), and pentaerythritol (PETN) were built and calibrated to support an independent validation and verification facility for explosive detection systems for the Federal Aviation Administration at the Idaho

National Engineering Lab. The explosive **vapor** generators will be used as **quant. vapor** stds. to establish the lower limits of detection of explosive detection systems. The generators were constructed using pure explosive suspended on quartz beads which were then loaded into a stainless steel tube. The tube was coiled and placed into a temp.-controlled chamber. A carrier gas (ultrapure air) was passed through the coil to carry the explosive mols. The generators are capable of delivering a pulse of varying explosive mass through the control of coil temp., airflow rate, and pulse width. Preliminary calibrations have been completed in the picogram to nanogram range using an ion mobility spectrometer as the calibrating instrument.

L18 ANSWER 118 OF 150 CA COPYRIGHT 2004 ACS on STN

AN 116:59450 CA

TI Surface chemistry of CVD reactions studied by molecular beam/surface scattering

AU Yu, Ming L.; Memmert, Ulrich; Buchan, Nicholas I.; Kuech, Thomas F.

CS T. J. Watson Res. Cent., IBM, Yorktown Heights, NY, 10598, USA

SO Materials Research Society Symposium Proceedings (1991), 204 (Chem. Perspect. Microelectron. Mater. 2), 37-46

AB A mol. beam/surface scattering expt. in an ultrahigh vacuum is conceptually a simulation of a chem. vapor-deposition (CVD) reactor without the interference from gas-phase and wall reactions. The surface chem. was studied in real-time during the deposition reaction at the desired temp. In our expt., we used **pulsed** mol. beams of the **reactants** and a mass spectrometer to **monitor** in real-time the reaction products evolving from the substrate surface. With this arrangement, the reaction probability of the mols. are readily detd. by measuring the unreacted fraction of the mol. beam. The reaction pathways are deduced from the identification of the reaction products, while their time-evolutions give the kinetic parameters. This technique is illustrated by the reactions of R<sub>3</sub>Ga (R = Me, Et) on GaAs as related to the metal-org. CVD and at.-layer epitaxy of GaAs.

L18 ANSWER 119 OF 150 CA COPYRIGHT 2004 ACS on STN

AN 115:235553 CA

TI Selectivity improvement using alternate flushing and reactant cycle steps

AU Lang, X. S.; Silveston, P. L.; Hudgins, R. R.

CS Dep. Chem. Eng., Univ. Waterloo, Waterloo, ON, N2L 3G1, Can.

SO Canadian Journal of Chemical Engineering (1991), 69(5), 1121-5

AB When a reactor is operated by alternately exposing the catalyst to hydrocarbon and oxygen, selectivity increases, but not for all partial oxidn. products and not for all systems. Here, multi-step periodic operation in which the catalyst is alternately exposed to hydrocarbon and air with an inert **gas pulse** between either or both of the **reactant** gases is **examd.** Partial oxidn. of butadiene over a promoted vanadia molybdate catalyst was used. The effects of cycle period and the location and duration of the inert flush on oxygenate prodn. and yield were studied. Multi-step periodic operation using an inert gas for flushing was not attractive in the prodn. of maleic anhydride from



butadiene unless an increase in the yield of furan is desired.

- L18 ANSWER 124 OF 150 CA COPYRIGHT 2004 ACS on STN  
AN 110:78541 CA  
TI Interpretation of data from a **pulse reactor**  
AU Desai, Naynesh S.; Anthony, Rayford G.  
CS Dep. Chem. Eng., Texas A and M Univ., College Station, TX, 77843, USA  
SO AIChE Symposium Series (1988), 84(266, Diffus. Convect. Porous Catal.), 73-9  
AB A theor. anal. of the data obtained from a microcatalytic **pulse reactor** is presented. The reaction  $A \rightarrow \text{products}$  is considered to occur in a porous catalyst. Data are computer generated for the cases with and without the usual pseudo-steady-state assumption for the rates on the surface of the catalyst. The specific rates of adsorption, desorption, and reaction are varied over a wide range. The pseudo-steady-state assumption is valid for the **pulse reactor**. When the kinetic parameters are known for the reaction, the effective diffusivity can be detd. The study illustrates the possibility of misinterpreting data from a microcatalytic **pulse reactor** in a steady-state anal. because 1st-order plots can be obtained with a Hougen-Watson type rate equation when intraparticle diffusional resistance is significant.
- L18 ANSWER 126 OF 150 CA COPYRIGHT 2004 ACS on STN  
AN 109:152711 CA  
TI An ambient-pressure **pulse microreactor** with continuous thermogravimetric and on-line chromatographic analyses for catalytic cracking  
AU Dean, John W.; Dadyburjor, Dady B.  
CS Dep. Chem. Eng., West Virginia Univ., Morgantown, WV, 26506-6101, USA  
SO Industrial & Engineering Chemistry Research (1988), 27(10), 1754-9  
AB An integrated system was designed to permit TGA anal. of the wt. change of a catalyst and chromatog. **analyses** of **reactants** and products using a **pulsed reactant**. A detailed anal. of the transient wt. change is not necessary, a significant advantage to this technique. A sample collection system was designed with semicontinuous, split-phase operation. This permits ambient pressure conditions in the reactor while higher pressures are used in the gas chromatograph, for quant. sample analyses from the pulse. Wt. changes of  $<1 \mu\text{g}$  are **detectable**, and **reactant** vols. in the  $\mu\text{L}$  range are used. The system was used to study deactivation of cracking catalysts by coking.
- L18 ANSWER 128 OF 150 CA COPYRIGHT 2004 ACS on STN  
AN 108:8160 CA  
TI Quantification of flow hydrodynamics in pulse thermogravimetric analysis systems  
AU Dadyburjor, D. B.; Dean, J. W.  
CS Dep. Chem. Eng., West Virginia Univ., Morgantown, WV, 26506, USA  
SO AIChE Journal (1987), 33(11), 1829-34  
AB A test is presented for comparing flow hydrodynamics in different thermogravimetric anal. (TGA) systems used as **pulse microreactors**. The

test involves passing a pulse of injectant over the sample pan contg. an adsorbent. Water and zeolite are used in the present case. The technique is easily performed and is insensitive to variations in temp. A model is developed by which the fraction of the **gas pulse** bypassing the sample pan within the TGA can be obtained. In gas/solid reactions, either catalytic or noncatalytic, the test should prove useful for comparing TGA extent-of-conversion data to similar measurements taken from other reactor configurations, carrier flow rates, and flow geometries.

L18 ANSWER 143 OF 150 CA COPYRIGHT 2004 ACS on STN

AN 85:182907 CA

TI Simultaneous use of a heat-flow microcalorimeter and of a **pulsed** or dynamic **reactor** for the study of adsorption or heterogeneously catalyzed reactions

AU Gruia, Maria; Jarjoui, Milad; Gravelle, Pierre C.

CS Inst. Rech. Catalyse, Villeurbanne, Fr.

SO Journal de Chimie Physique et de Physico-Chimie Biologique (1976), 73(6), 634-40

LA French

AB A microcalorimetric app. for measuring the thermal effects produced in a dynamic or **pulsed reactor** is described. **Anal. of reactants** or products is achieved by means of a gas chromatog. Calibration and preliminary expts. are detailed. When used with a **pulsed reactor**, this app. can serve to **measure** heats of adsorption of a gaseous **reactant** on an adsorbing solid or heats of interaction between a gaseous reactant and preadsorbed species. When used with a dynamic reactor, this app. can serve to study reaction kinetics and the activation or deactivation of the catalyst. Examples are given to illustrate the applications of this new technique.

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